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ABSTRACT

The purpose of this study was to broaden the aptitude by treatment interaction paradigm. The relationship between memory span and performance in two different transfer conditions was examined, and task involvement and anxiety were considered as they contribute to the relationship between aptitudes and performance. (CK)

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EFFECTS OF ANXIETY ON APTITUDE BY TREATMENT INTERACTIONS

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Subsequent to Cronbach's address (1957) which stressed the importance of achieving a rapproachment between the experimental and correlational fields of psychology, there have been a number of studies designed to assess the relationship between cognitive aptitudes and performance on various learning tasks (Fleishman, 1960; Bunderson, 1967; Duncanson, 1966; and Dunham, Guilford and Hoepfner, 1968). Moreover, recent experimental work has demonstrated that observed relationships between aptitudes and performance vary under different experimental treatments.

For example, Dunham and Bunderson (1968) demonstrated that instruction regarding a concept learning rule alters the relationship between cognitive abilities and performance. There were two experimental groups: the rule group was instructed concerning the nature of a rule for learning the concept whereas the no-rule group did not receive this instruction. Although there were no significant mean differences between the performance of the rule and no-rule groups, the rule instruction did have a role in determining which abilities had significant relationships to performance. Consequently, the instructions did help to determine which Ss succeeded on this task. In other words, it was found that rule instruction reduced the role of associative memory and enhanced the likelihood that an individual high in reasoning ability would achieve success on the problem.

These studies are often referred to as aptitude by treatment interaction (ATI) studies. The purpose of the present study was to broaden the aptitude by treatment interaction paradigm. First, the relationship between memory span and performance in two different transfer conditions is examined. Second, task involvement and anxiety are considered as they contribute to the relationship between aptitudes and performance.

Unannounced extra-dimensional shift problems using the same dimensions and values on the original and transfer learning trials have consistently

produced a negative transfer effect in the experimental literature (Wolf, 1967). The present study employed two types of extra-dimensional shift problems (with either the same or new values) in order to confirm this effect with unidimensional problems (four values for each of five dimensions).

The work of Spence and his colleagues (Spence and Spence, 1966) and Spielberger and his colleagues (Spielberger, 1966) indicates that anxiety has a relatively debilitating effect on the performance of tasks which have high numbers of competing responses. If a negative transfer effect can be used as one way to define a task with high numbers of competing responses, then it would be predicted that anxiety would have a debilitating effect on the performance of problems with negative transfer.

It has been found that high and low ego-involvement instructions sometimes produce significant differences in mean performance on learning tasks (Sarason and Palola, 1960). Perhaps more importantly, it has also been reported that anxiety interacts with ego-involvement instructions such that the anticipated relationships between anxiety and learning occur with high involvement rather than neutral instructions (Spielberger and Smith, 1966; Sarason, 1956). The present study included both high and low ego-involvement instructions.

Perhaps most importantly, Denny (1966) investigated the interactive relationship between anxiety and intelligence as they affect concept learning. In order to insure differences based on anxiety, all Ss received high ego-involving instructions. He grouped Ss (introductory psychology students at Duke University) on the basis of high and low (upper and lower 20%) scores on the Manifest Anxiety Scale and also high and low scores (median split; high mean = 1270; low mean = 1037) on an intellectual measure (College Entrance Examination Board, SAT). This produced four groups: high anxiety-high intelligence (HA-HI), high anxiety-low intelligence (HA-LI), low anxiety-high intelligence (LA-HI), and low anxiety-low intelligence (LA-LI).

High anxiety was found to facilitate the performance of high intelligent Ss, while it debilitated the performance of low intelligent Ss. In other words, figure 1 reveals that the performance of HA-HI Ss was superior to that of the LA-HI Ss, whereas the performance of HA-LI Ss was inferior to that of the LA-LI Ss.

However, an analysis of this study reveals a restricted conception of intelligence in that a general measure of intelligence is employed. On the basis of data indicating that different tasks may place emphasis on different abilities, it was determined that a consideration of specific abilities rather than a general measure of intelligence might provide a more detailed test of the hypothesis that anxiety interacts with cognitive factors as they relate to learning performance. Consequently, the present study considered anxiety, ego-involvement, and aptitudes as they affect performance on two types of transfer conditions (one with high and one with relatively low numbers of competing responses associated).

METHOD

Subjects

The Ss were 180 introductory educational psychology students at the University of Texas at Austin. Prior to the experimental conditions Ss were administered a battery of tests. The Taylor Manifest Anxiety Scale was used to assess anxiety, and the following tests were taken from the French Kit of Reference Tests (French, Ekstrom and Price, 1963): First and Last Names (associative memory); Ship Destinations (general reasoning); Letter Sets (induction); Hidden Patterns (flexibility of closure); and Auditory Number Span (memory span).

Procedure

There were four experimental conditions which were defined by all combinations of two types of ego-involvement instructions (high and low ego-involvement) and two types of concept learning transfer conditions. Prior to the experimental task, Ss were administered either high or low ego-involvement instructions (adapted from Sarason, 1956).

During the concept learning task, all Ss received two consecutive unidimensional, four-category concept problems. The second problem served as the transfer problem and was begun immediately after a criterion of 13 consecutive correct responses was reached on the first problem. The transfer conditions were extradimensional shifts which differed as to whether the dimensions and values of the transfer problem were the same (negative transfer problem) as those in the original learning problem or consisted of new (positive transfer problem) dimensions and values. It was expected that the shift with same values would have a negative transfer effect (e.g. performance on the transfer learning problem would be inferior to performance on the original learning problem), whereas it was expected that there would be no such negative transfer effect for the shift with new values (e.g. performance would be essentially the same on the transfer and original learning problems). Consequently, it was expected that the negative transfer problem would have more competing responses associated than the shift with new values.

Results

The results were analyzed with multiple linear regression procedures. As noted above there were four treatment groups, and in addition, anxiety and memory span were considered simultaneously as covariables. Change scores were used as the dependent measure to assess transfer (number of trials to criterion on transfer learning problem; number of trials to criterion on original learning problems).

It is important to note that although these procedures employed both anxiety and ability measures as covariables, the regression analysis was designed to assess the effect of these covariables on performance, and not to control for their effects as is traditionally done with covariance analyses. More specifically, the traditional covariance analysis either tests for or assumes homogeneity of regression lines in the different treatment groups. If this assumption is supported then the test is made to see whether the intercepts are equal at a given level of the covariable (usually the mean). The regression analyses used in this study did not compute the intercept test. On the other hand, the preliminary test for homogeneity of regression lines was completed. If the F was significant and the assumption of homogeneity of regression lines was rejected, then it was concluded that there was a covariable by treatment interaction.

In other words, the relationship between covariable and performance was defined in terms of the slope (amount of change in the criterion per unit change in the covariable) of the regression line for each treatment group. Where the slopes of htese regression lines were found to be significantly different it was concluded that the relationship between the continuous variable and performance was dependent on the treatment group and this defined a covariable by treatment interaction.

The four way interaction between shift condition, involvement instructions, anxiety and memory span approached significance, $\underline{F}$ (3,164)=2.2; $\underline{P}$<.09. Moreover, a more detailed analysis of the data revealed that this result was attributable to interactions between anxiety and memory span in the low involvement conditions. The interaction between anxiety and memory span was significant in the low involvement-positive transfer condition, $\underline{F}$ (1,166)=2.8; P<.03; and this interaction approached significance in the low involvement-negative transfer condition, $\underline{F}$ (1,166)=3.6; $\underline{P}$<.06; Figures two and three

represent these interactions.

Insert Figures 2 & 3

The nature of the interaction between anxiety and memory span was such that the positive relationship between mamory span and performance was inhibited for Ss with high anxiety.

Figures 2 and 4 represent the relationship between anxiety and memory span as they affect performance in the low involvement-negative transfer and the high involvement-negative transfer conditions. If the performance score of Ss with average anxiety is considered, it is noted that in each case the expected negative transfer effect for this problem does not occur for Ss high in memory span. Moreover, the significance of this finding becomes even more apparent when it is considered that an analysis of variance with the present data reported a significant negative transfer effect, F (1,164) = 5.9; $P < .02$.

Insert Figure 4

Discussion

The interactions obtained between anxiety and memory span, which were the primary concern of the present study, are of particular interest in light of the correlation between anxiety and memory span. While previous studies have indicated a negative correlation between anxiety and memory span, the results of this study do not support this conclusion (r = -.07). On the other hand, this lack of correlation does not eliminate the possibility of any relationship between anxiety and performance as is evident in the significant interaction between the manifest anxiety scale and memory span as they affect learning. Moreover, this interaction

supports the general concept of a negative relationship between anxiety and memory span as figures 2 and 3 reveal that high anxiety appears to inhibit the utilization of memory span in the solution of the concept problem.

Although both the present study and the experiment by Denny revealed significant interactions between anxiety and cognitive factors as they affect performance, the nature of these interactions is quite different. In Denny's study anxiety was facilitating for the performance of Ss with high intelligence and anxiety was debilitating for Ss with low intelligence. On the other hand, figure 2 reveals that anxiety was debilitating for the performance of Ss with high rather than low memory span in the low involvement-negative transfer condition; and figure 3 reveals that anxiety was facilitating for the performance of Ss with low rather than high memory span in the low involvement-positive transfer condition.

It should also be noted that the anxiety by memory span interactions occurred only with low ego-involvement instructions. It may be that increased motivation to perform was associated with high ego-involvement and this may have inhibited these interactions. Here is a clear example where treatment conditions brought the relationship between cognitive ability and performance under control.

The relationship between memory span and negative transfer was particularly important. If the analysis of variance data had been used a main effect for the transfer conditions would have been reported. However, a consideration of memory span produced a more precise description of the negative transfer effect.

More importantly, the negative transfer effect has consistently been reported in the literature, and this is the first instance where it has been shown that this effect does not hold for all Ss. Those Ss with high memory span ability avoided negative transfer.

In addition, this result is interesting because it seems to be counter intuitive and it is inconsistent with previous explanations of the negative transfer effect. Previously it had been hypothesized that Ss with high memory span would remember the responses on the original learning task. Consequently, the responses learned during original learning would interfere with learning of the transfer learning problem. Thus, it might have been predicted that high memory span ability would enhance the negative transfer effect. In addition, since this interaction effect did not occur with the remaining abilities it must be concluded that this effect was specific to memory span ability rather than being due to some general intellectual ability.

This study adds support to the assumption that bridging the gap between the correlational and experimental disciplines of psychology, as suggested by Cronbach (1957) can provide a research methodology which can answer more complex questions about human behavior than have traditionally been asked. Specifically, multiple linear regression procedures were successfully employed to help answer complicated questions relevant to the relationship between continuous (covariables) variables and performance in various experimental conditions.

In summary, the present investigation demonstrated significant anxiety by memory span by treatment interactions. More specifically, it appears that high anxiety may inhibit the utilization of memory span with this sort of concept task, and that high ego--involvement may create a motivation to succeed which reduces the interactive effects with anxiety. In addition, it was found that high memory span prevented the negative transfer effect. These findings were the primary focus of the study, and they provide support for the notion that not only treatment conditions but also personality and motivational factors should be considered within the aptitude by treatment interaction paradigm.

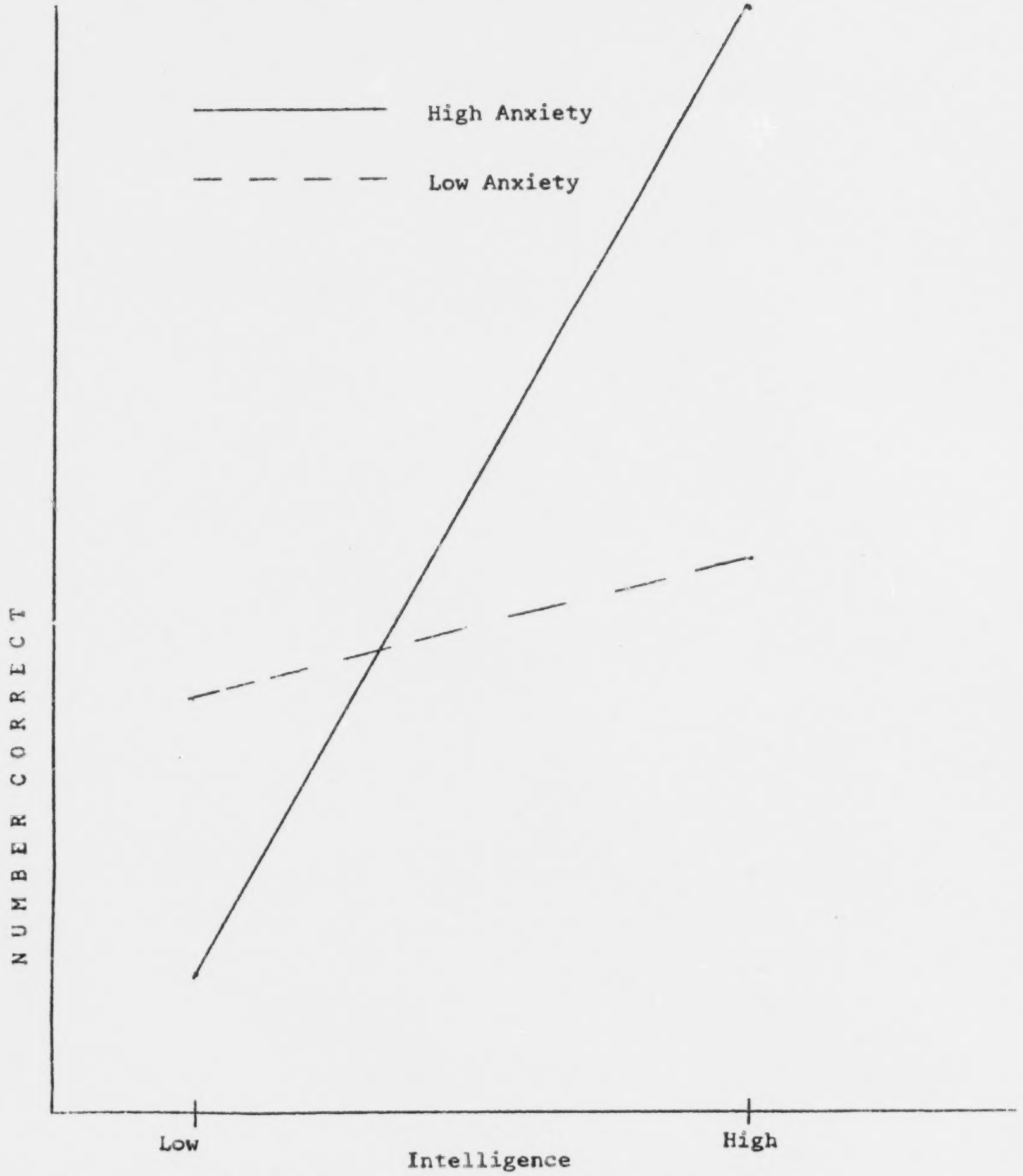

Figure 1. Interaction between intelligence and anxiety; Denny, 1966.

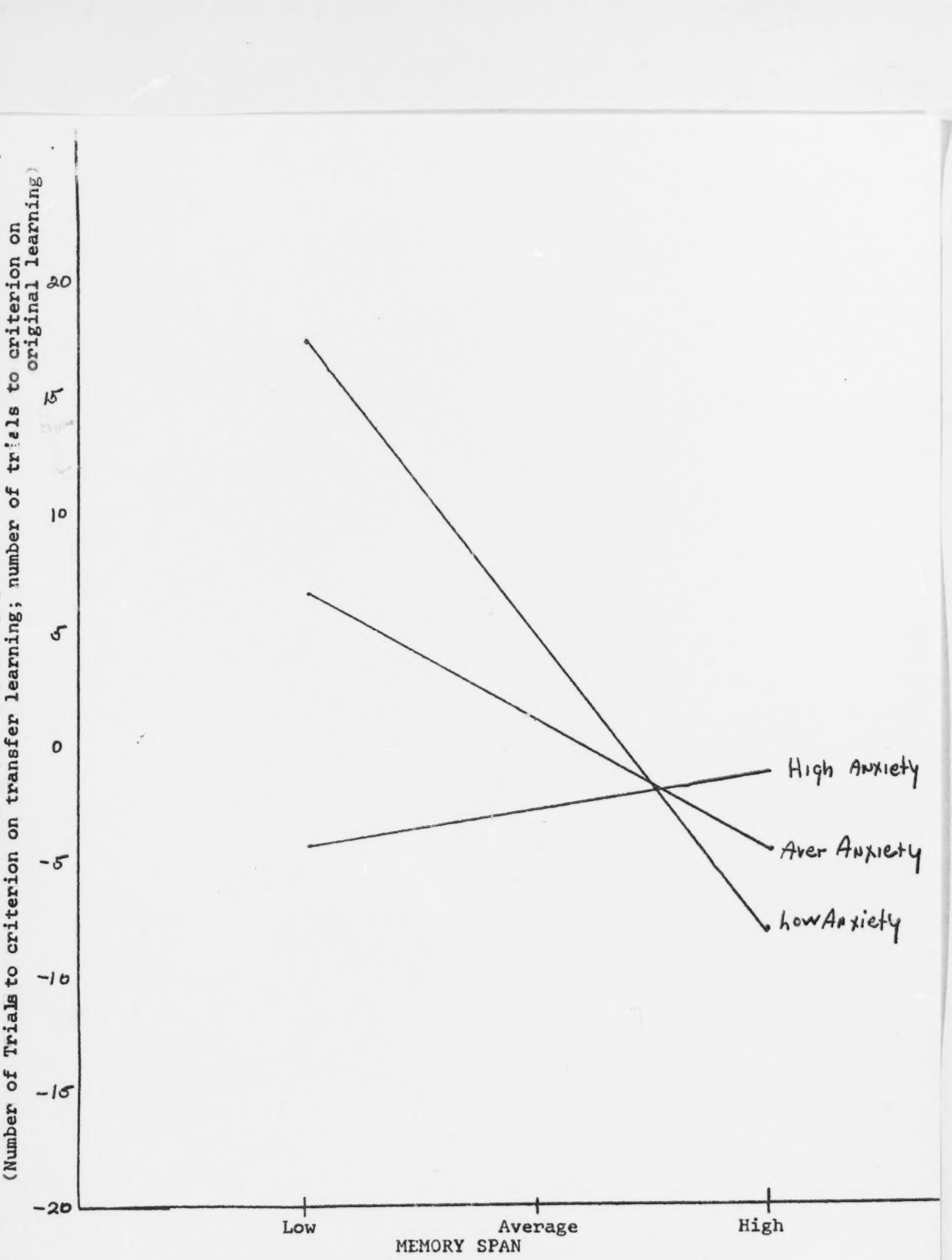

Figure 2. Anxiety X Memory Span Interaction, Low Involvement-Positive Transfer Condition.

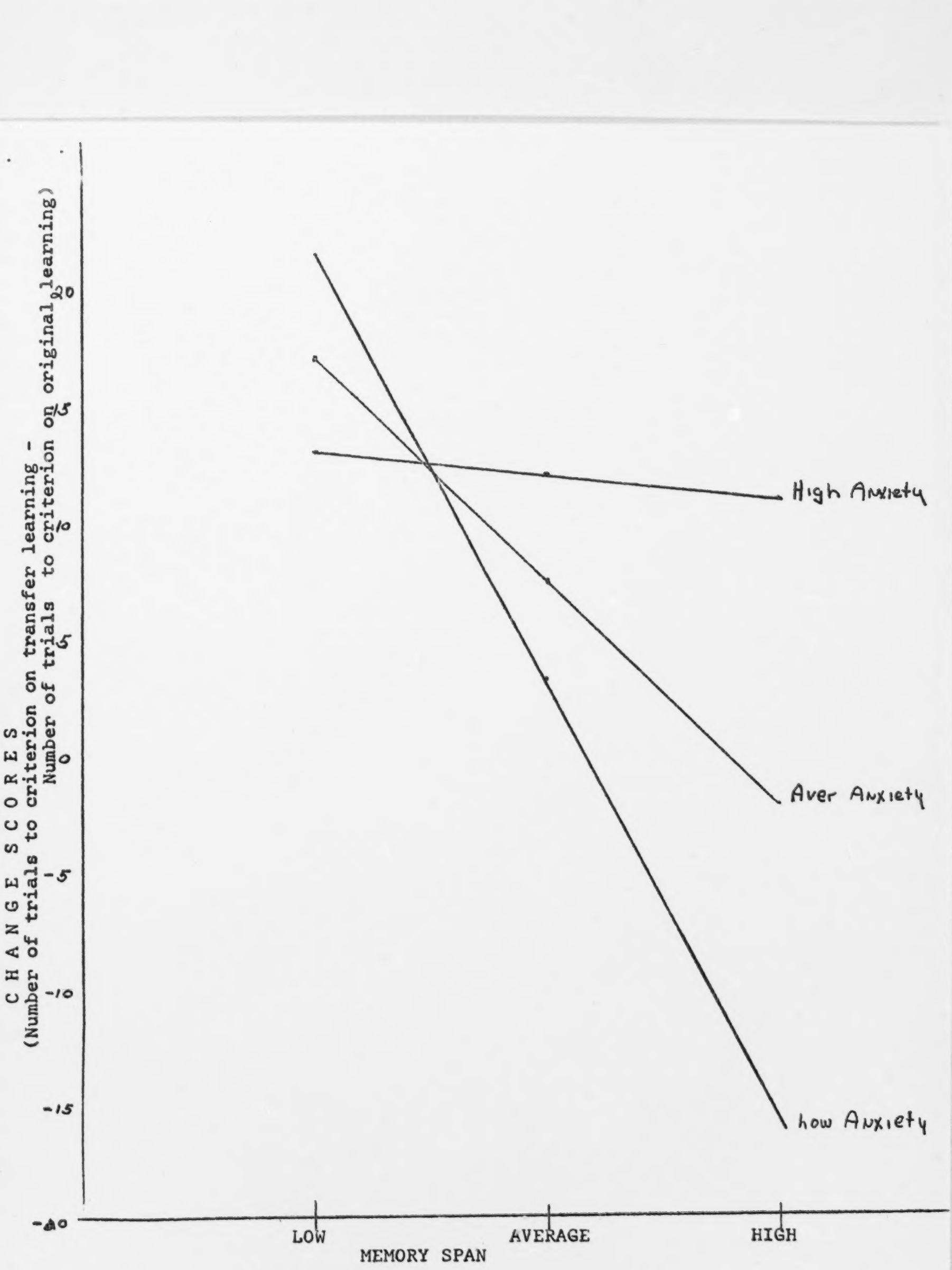

Figure 3. Anxiety X Memory Span Interaction,
Low Involvement - Negative Transfer Condition

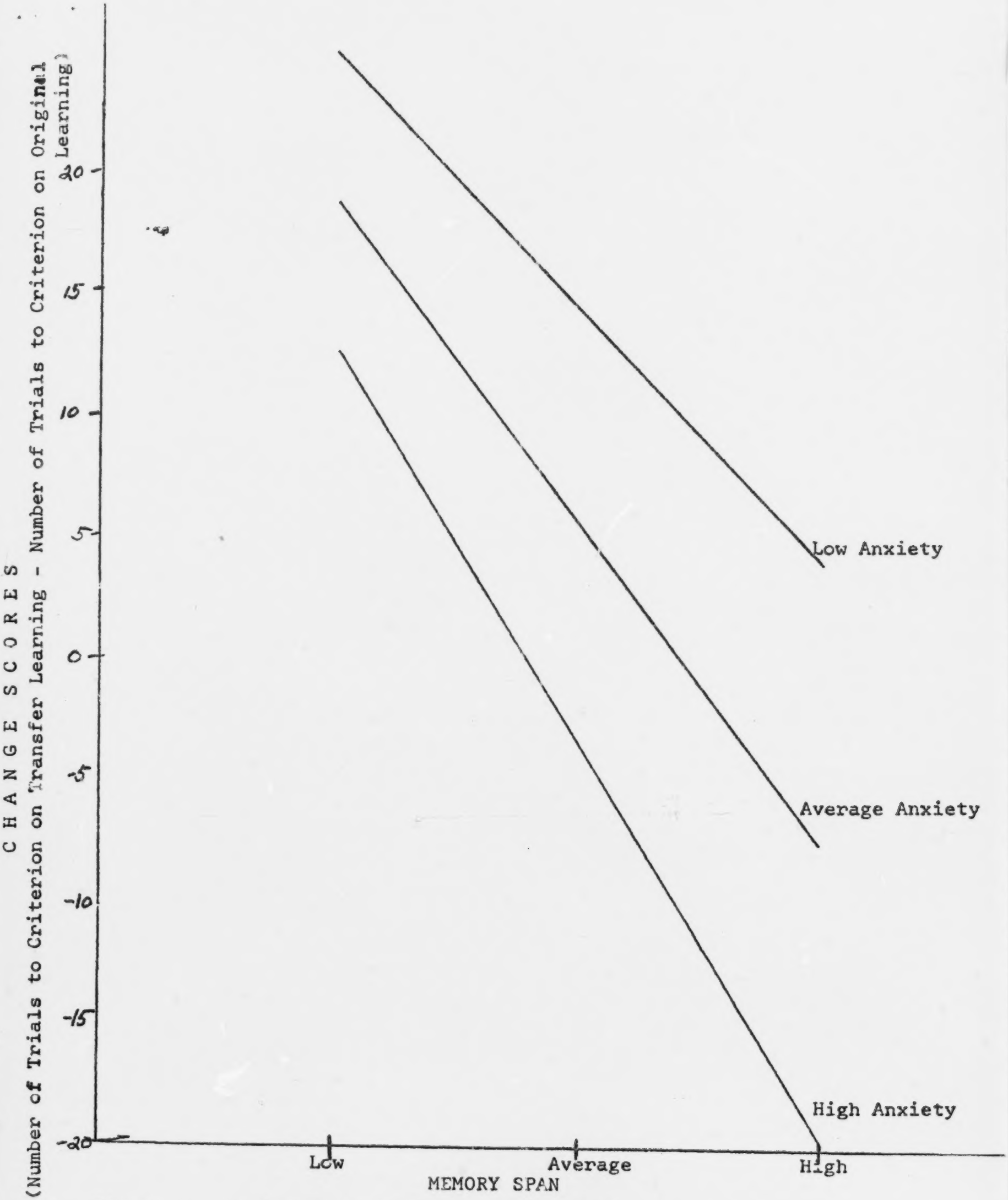

Figure 4. Anxiety X Memory Span Interaction,
High Involvement - Negative Transfer Condition

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